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RESEARCH ARTICLE

An empirical analysis of organized crime, corruption and economic growth

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Abstract In a companion study, Blackburn et al. (Econ Theory Bull, 2017), we have developed a theoretical framework for studying interactions between organized crime and corruption, with the view of examining the combined effects of these phenomena on economic growth. The analysis therein illustrates that organized crime has a negative effect on growth, but that the magnitude of the effect may be either enhanced or mitigated in the presence of corruption. In this paper we tackle the ambiguity produced by the coexistence of the two illicit activities with an empirical investigation using a panel of Italian regions for the period 1983–2009. We find that organized crime distorts growth less when it coexists with corruption and show our results to be robust to different specifications, measures of organized crime, and estimation techniques.

Keywords Corruption · Economic growth · Italy · Organized crime

JEL Classification C23 · K49 · O43

1 Introduction

It is well-accepted that criminal organizations typically involve the collusion or direct participation of the public sector in their illegitimate activities. In 1994, the United Nation's Naples Declaration officially recognized that organized crime has a "corrupting influence on fundamental social, economic, and political institutions", and that it commonly uses "violence, intimidation and corruption to earn profit or control

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territories or markets".[1] More recently, a survey based on public perceptions of the links between corruption and organized crime conducted by Eurobarometer (2006), revealed that more than half of European citizens believe that most of the corruption in their countries is related to organized crime. Even more recently, in 2015, the United Nations have agreed on seventeen new global Sustainable Development Goals as part of their 2030 Agenda.[2] Amongst them, Goal 16: Peace, Justice and Strong Institutions, acknowledges the links between these two illicit phenomena and highlights the importance of combating them jointly.

It is not difficult to understand that criminal syndicates strongly depend on, and encourage, corruption in order to carry out their activities with reduced risk of detection and prosecution. Such activities are likely to be more successful with the compliance of law enforcement officers who are willing to accept bribes in return for various favors. Due to this relationship, organized crime can foster corruption at all levels of public office. This is evidenced in a report by Center for the Study of Democracy (2010) which focuses on the links between organized crime and corruption in 27 European Member States. The report reveals that criminal organizations have strong links and in-roads to police forces, using their influence to gain access to undisclosed information on investigations, to guarantee endurance of operations, and to develop and maintain monopolies in local markets. The report also emphasizes the significant relationship between organized crime and political corruption (ranging from government ministers and other high-level politicians, to local mayors and city councilors).

The general conclusion of most observers and practitioners is that organized crime flourishes most when the functioning of society's public institutions is undermined by corruption. Evidence of this can be found in several empirical studies covering various countries in different regions of the world and at different stages of socio-economic development: examples include Mazzitelli (2007) for West Africa, Sergi and Qerimi (2007) for South-East Europe, and Buscaglia and Van Dijk (2003) for a more global sample of territories. Theoretical work on the issue has focused largely on the role of corruption in influencing and compromising strategies to combat organized crime. Becker and Stigler (1974) were the first to point out that the payment of bribes by criminals to law enforcers can weaken the threat of prosecution for criminal activity, suggesting that deterring such activity could be strengthened by remunerating public enforcers sufficiently well and/or paying private enforcers according to performance. In subsequent work, Bowles and Garoupa (1997) showed why the standard prescription of imposing the maximum fine on criminals may not be optimal when there is complicity between the criminal and arresting officer at the expense of the police department. Chang et al. (2000) introduce subjective psychic costs of corruption (moral shame and social stigma), demonstrating how social norms may create conditions under which an increase in fines for criminal activity are counter-productive. Along related lines, Kugler et al.

[1] UN GA Resolution 49/159 Naples Political Declaration and Global Action against Organized Transnational Crime (23/121994); UN GA Resolution 1996/27 Implementation of the Naples Political Declaration and Global Action Plan against Organized Transnational Crime (24/07/1996).

[2] For details, see https://sustainabledevelopment.un.org/sdgs.

(2003) identify circumstances where strategic complementarities between corruption and organized crime mean that tougher sanctions on crime produce higher rates of crime, whilst Polinsky and Shavell (2001) suggest that sanctions against corruption, rather than sanctions against crime, are optimal in mitigating criminal behavior.

Whilst the foregoing research has yielded valuable insights on the links between corruption and organized crime, there is still considerable room for further investigation. A particularly fertile area, which so far has gone undetected, is the extent to which this link may have an influence on overall economic performance. An attempt in this direction has been made by Blackburn et al. (2017) in a companion study (henceforth BNR), who took a step beyond the partial equilibrium analysis of individual decision making towards the relatively unexplored general equilibrium analysis of aggregate growth outcomes. In a series of overlapping generations endogenous growth models, BNR study the interactions between organized crime and corruption, together with the individual and combined effects of these phenomena on economic growth. In this environment, a criminal organization co-exists with law-abiding productive agents and potentially corrupt law enforcers. The crime syndicate obstructs the economic activities of agents through extortion, and may pay bribes to law enforcers in return for their compliance in this. The first finding of the analysis is that the presence of organized crime on its own reduces economic performance by deterring agents from engaging in growth-promoting ventures. The second finding, and the main contribution of the study, is that this effect may be either exacerbated or mitigated by the coexistence of both organized crime and corruption. In other words, the analysis gives rise to an ambiguity of the comparative static over the equilibrium growth rate with crime as compared to the growth rate with both crime and corruption.

Prompted by the inconclusive result of BNR, in this paper we conduct a rigorous econometric analysis with the aim of resolving the above ambiguity. We carry out an investigation at the cross-regional level for Italy due to the wealth of data on crimes ascribable to organized criminal groups, unavailable at the international level. Importantly, the variety of data on Mafia-related crimes, available for a rather long period, allows us to construct a multiplicity of indexes that proxy for the different activities that typically involve organized criminal organizations. Using growth regression analysis for the period 1983–2009, we find strong evidence that the growth-reducing effect of organized crime is less severe in the presence, than the absence, of corruption. We interpret this as evidence that in the presence of criminal activity, corruption ameliorates the negative effects of organized crime on growth. This finding lends support to one of the two plausible theoretical possibilities and suggests the joint treatment of the two illegal phenomena in the context of growth analysis.

The remainder of the paper is structured as follows. Section 2 presents a summary of the theoretical model developed in our companion paper. Section 3 describes the empirical investigation and strategy, while Sect. 4 presents the data. Section 5 discusses the main findings and Sect. 6 reports on further robustness analysis. Some concluding remarks are given in Sect. 7.

2 Descriptive summary of a model

In this section, we briefly describe the theoretical model developed in BNR and illustrate its main predictions.[3] The general framework used in our theoretical analysis describes a dynamic, endogenously-growing economy populated by heterogeneous agents engaged in different occupations. The engine of growth is capital accumulation, and the set of occupations may include both legal and illegal activities. The former consist of the production of output and capital, together with the enforcement of governance. The latter consist of illicit profiteering by private individuals and public officials. The description of the model proceeds in three stages. In the first stage, we assume an economy free from any malevolent behavior. In the second stage, we introduce such behavior in the form of organized criminal activity, while in the third stage we also add corruption and explore the implications of the coexistence of these two phenomena for economic growth.

In each of the stages, we consider an overlapping generations economy in which there is a constant population of two-period-lived agents. Each generation of agents is divided at birth into two groups of citizens—a unit mass of households (or workers) and a unit mass of firms (or entrepreneurs). The former are suppliers of labor when young and consumers of output when old. The latter are (potential) producers of capital when young, and producers and consumers of output when old. All agents are risk neutral and all markets are competitive.

The key aspect of the model and the driver of economic growth is the mass of entrepreneurs, who have heterogeneous effort costs. The measure of these producers who decide to invest on a project from which capital is produced depends on their perceived effective rate of return, which gives rise to a critical level of required effort above which capital production is undertaken by an entrepreneur. With the key factor in determining growth being the population of capital producers, any aspect of the environment that influences the critical level of effort, also influences the equilibrium growth rate of the economy. In the absence of any illicit behavior, where agents operate under perfect markets and perfect governance, growth depends only on the return from, and cost of, undertaking capital production. As such, growth is higher the greater is the number of entrepreneurs who optimally choose to be producers of capital.

In the second stage, we introduce crime into the model by considering the case in which entrepreneurs are exposed to extortion by an illicit organization, the Mafia. Like all other agents, the Mafia behaves optimally by choosing its racketeering activities so as to maximise its expected payoff. Implicit in the model is a system of law enforcement designed to obstruct and prevent, detect and prosecute, criminal behavior. It is assumed that the law enforcers act with full integrity in executing their crime prevention duties, i.e., they are not corruptible. In this environment, the Mafia extorts a payment from each capital producer due to a threat of personal damage. It is the payment of the extortion that gives rise to a lower critical level of required effort, compared to the absence of Mafia, above which an entrepreneur chooses to engage in capital production. This, in turn, means that organized crime has the effect of deterring capital production by

[3] For a formal analysis of the model, we direct the interested reader to the study.

some entrepreneurs who would have otherwise engaged in this venture. As an outcome, organized crime lowers the equilibrium growth rate compared to an economy without crime since it effectively acts as a tax on the entrepreneurs' expected returns.

In the third stage, we consider the case in which law enforcers are potentially willing to accept bribes from the Mafia in return for turning a blind eye to the Mafia's activities. Therefore, a criminal organization co-exists with law-abiding productive agents and potentially corrupt law enforcers. As before, the crime syndicate impedes legitimate economic activities through extortion, but now it may also bribe law enforcers. This means that the payment of bribes acts a tax on the criminals' expected return, which alongside the extortion applied on entrepreneurs, creates an unfavorable business environment. The outcome is a higher cost of investment for entrepreneurs that reduces their number and, subsequently, economic growth. Both costs of illegal activities on the formal economy-extortion and bribes-show that growth in a badly-governed economy is lower than growth in a well-governed economy.

The main message of the analysis is that an economy performs better when it is free from all crime and corruption than when it is saddled with either or both these. But, is an economy damaged by more or less if crime occurs alone than if crime co-exists with corruption? The analysis provides no definitive answer to this question. Since the ultimate factor in impeding growth is the Mafia's extortion of capital producers, the question of which type of environment suffers the most damage is effectively a question of which type of environment suffers the most racketeering. This reduces to a comparison between the expected extortion payment in the presence of crime alone with the extortion payment in the presence of both crime and corruption. Intuitively, corruption reduces the supply of crimes, but makes crimes that occur more likely to be successful. This makes comparative statics ambiguous on the equilibrium growth rate with organized crime versus the growth rate with both crime and corruption. Thus, the foregoing descriptive analysis shows that the impact of organized crime may be conditional on the presence of corruption, and the direction could go either way—organized crime may be more or less damaging if it co-exists with corruption. It is this ambiguity we tackle next with our empirical investigation.

3 Estimation strategy and techniques

The ambiguous prediction of the theoretical analysis in BNR leaves open the question as to whether the combination of organized crime and corruption is more damaging to an economy than organized crime alone. We now proceed to an empirical investigation of the issue using regional Italian data over a 27 years history in order to shed light to this indefinitive result.[4] Ideally, one would seek to resolve the issue by first considering an economic entity's growth performance in the absence of both organized crime and corruption, and then adding each of these factors in turn until both are accounted for simultaneously. In this way, one could assess the growth effect of organized crime both in isolation and in conjunction with corruption. In the absence of this ideal scenario

[4] The use of data on Italian regions, rather than at the cross-country level, is primarily driven by the availability of long time series and by the wealth of data and measures of organized crime.

that has been followed in the theoretical framework, our empirical strategy involves specifying a growth equation that controls for both organized crime and corruption, amongst other variables. This growth equation is directly derived from the growth rate expressions in BNR when only organized crime is present and when it coexists with corruption [see Eqs. (15) and (22) of the model], after log-linearization around the steady state. The major element of this growth regression equation is an interaction term between the two illegal activities, which we use to proxy for the growth effect of organized crime in the presence of corruption.[5] It is this interaction term that commands most of our attention: the finding of a positive (negative) coefficient on this term would support the argument that organized crime has a less (more) severe effect on growth when it is accompanied by corruption.[6]

Given the above, our empirical set-up is represented by the following regression equation,

$$g_{i,t} = \alpha + \beta_1 OC_{i,t} + \beta_2 Corr_{i,t} + \beta_3 (OC \times Corr)_{i,t} + \sum_{j=1}^{m} \gamma_j X_{j,it} + \mu_i + \varepsilon_{i,t}, \tag{1}$$

where variables are indexed by both region, i, and time period, t. These variables are as follows: g is the growth rate of per capita real GDP; OC is a measure of organized crime; $Corr$ is a measure of corruption; X is a set of standard control variables; μ captures unobserved time-invariant region-specific effects; and ε denotes a time-varying error term. The crucial component is $(OC \times Corr)$, which represents the interaction term between organized crime and corruption.

The set of controls, X, comprises the usual explanatory variables that are included in growth regressions (e.g., Barro 1991; Levine and Renelt 1992; Sachs and Warner 1997). These are the log of initial real GDP per capita, the ratio of investment to GDP, the rate of inflation (as measured by the GDP deflator), and the rate of secondary school enrolment. In addition to these baseline variables, we consider an extended group of controls, composed of the rate of population growth, the ratio of trade to GDP, the share of total public spending to GDP, and an indicator of financial development.

Our measure of corruption, $Corr$, departs from the corruption perception indices that are used most commonly in cross-country empirical work.[7] The measure that we employ is the official number of crimes against public administration per 100,000 inhabitants reported to the police and published by the Italian National Institute of Statistics (ISTAT). The crimes that we consider are based on Statutes no. 286 through 294, which include crimes of peculation and embezzlement. Other crimes against

[5] The interaction term allows controlling for a key point in the models of BNR, the fact that the existence of corruption creates selection on the amount of equilibrium criminal activity. Further, the use of interaction terms as proxying for conditional effects in the economic growth process has become popular over the years. See, for example, Ahlin and Pang (2008) and Angeles and Neanidis (2009).

[6] In terms of the analysis in BNR, a positive (negative) interaction term would imply that p is large (small) relative to β, in which case $g^c < g^{cc}$ ($g^c > g^{cc}$).

[7] The most popular of these indices are the Corruption Perception Index (published by Transparency International), the International Country Risk Guide Index (published by Political Risk Services), and the Control of Corruption Index (published by the World Bank).

public administration, such as insulting a public officer (Statute 279) and neglect or refusal of an official duty (Statute 295), are excluded. The same measure has been used by Del Monte and Papagni (2001, 2007) in previous empirical analyses of corruption in Italy.[8] Needless to say, the measure may not give a full picture of corruption, and is likely to underestimate such activity, since it is based only on crimes that are reported.[9] Accordingly, the estimated coefficient on *Corr* may be viewed as representing a lower bound on the effect of corruption.

As regards our measure of organized crime, OC, we follow the existing literature (e.g., Caruso 2008; Daniele 2009; Daniele and Marani 2010; Pinotti 2011) by constructing different indices of such crime, based on different combinations of Mafia-related offences, and using these alternatively throughout the analysis.[10] Our preferred measure, however, is an index (labelled OC Index 5) composed of the sum of official data on five different types of crime that are indicative of the presence of criminal organizations, either by definition or by inference.[11] The five offences are: (i) criminal association (art. 416 Italian Penal Code), (ii) Mafia criminal association (art. 416 bis Italian Penal Code), (iii) homicides by the Mafia, (iv) extortion, and (v) bomb attacks.[12] A few comments on these are worth making.

Since 1982, the Italian judicial system has made a clear distinction between criminal association (art. 416) and criminal association of Mafia-type groups (art. 416 bis).[13] Common criminal association is defined as "the association of three or more people who are organized in order to commit a plurality of crimes". The characteristics of this kind of offence are the following: (i) the stability of the agreement amongst members, meaning the existence of an associative connection intended to be continuous through time, even after the crimes have been committed; and (ii) the existence of a programme of delinquency to commit an indeterminate number of crimes.[14] By contrast, a criminal

[8] We thank Erasmo Papagni for kindly sharing the data for the years 1961–2001. Data from 2002–2005 can be found online at the ISTAT website. For the most recent data on corruption (2006–2009), we thank ISTAT officers for the collection and transmission of the data.

[9] Moreover, as pointed out by Del Monte and Papagni (2001, 2007), the measure could also be affected by a systematic bias due to differences among regions in reporting crimes. This does not, however, seem to be case. By regressing the statistics on reported crimes of corruption and an index of the length of the judicial processes, the authors do not find any large systematic differences among regions in the proportion of reported and detected crimes to actual ones.

[10] The term Mafia is used to include all the main criminal organizations that are present in the different Italian regions, such as Cosa Nostra in Sicily, Camorra in Campania, N'drangheta in Calabria, and Sacra Corona Unita in Puglia.

[11] As pointed out by Daniele and Marani (2010) and La Spina and Lo Forte (2006), even if one cannot always distinguish organized crime from non-organized crime, it is possible to identify some types of offence (e.g., fraud, theft and sexual violence) as being uncharacteristic of Mafia-type groups.

[12] For all crimes, we use rates per 100,000 inhabitants reported by the police to the judicial authority. These data are available by ISTAT, Annals of Judicial Statistics.

[13] Until 1982, Article 416 of the Italian Penal Code ("associazione a delinquere") punished in the same way all groups of three or more people involved in some type of criminal activity. This generic term could not distinguish between small groups of bank-robbers and larger criminal networks with a powerful control over the territory. This changed in 1982 with the introduction of the crime "associazione a delinquere di stampo mafioso" provided by Article 416 bis (Law 646/82).

[14] This definition is similar to the one given by the UN Convention against Transnational Organized Crime (2004) which describes organized crime as a "…structured group of three or more persons existing for a

association is defined to be of the Mafia-type "when its members use intimidation, awe and silence (omert à) in order to commit crimes, to acquire the control or the management of business activities (i.e., concessions, permissions, public contracts or other public services), to derive profit or advantages for themselves or others, to limit the freedom of exerting the right to vote, and to find votes for themselves or others during the electoral campaign".[15] It is necessary to include both types of criminal associations in the definition of organized crime because often it is difficult to prove the Mafia associations, insofar many crimes that are classified as "simple" criminal association are actually Mafia criminal association.

The ultimate of all crimes, that one often associates with Mafia-type organizations, is homicide. As emphasised by MacDonald (2002), all judicial-based measures of crime are generally subject to under-reporting. This may be especially true for offences committed by criminal cartels, whose use of intimidation and violence can undermine the process and outcome of judicial investigations, particularly in regions where the crime syndicate wields a high degree of power and influence. At the same time, there is evidence to suggest that under-reporting tends to be smaller for very serious crimes (e.g., Fajnzylber et al. 2002; Soares 2004), hence the inclusion of Mafia-related homicides in the index of organized crime.

Another felony that is prominently linked with organized crime is extortion. Indeed, this is often regarded as the most typical Mafia offence, being a primary means of obtaining illegal income by preying on businesses. In Italy, the commonly-used term for extortion is the *pizzo*, meaning the black tax that the Mafia imposes on businesses to fund its various operations. According to the Italian shopkeepers association, Confesercenti (2009), "the pizzo ensures the everyday activity of criminal organizations, it increases its domain, it confers more prestige to the clans, and measures the rate of silence in a given area, headquarter, or community". This is echoed elsewhere in the literature, and it is well-documented that almost all the Mafia families exercise their power over a territory through the racket of extortion (see, for example, Daniele and Marani 2010). As Confesercenti (2009) also points out, official data on racketeering is often susceptible to the aforementioned problem of under-reporting. Nevertheless, the staggering scale of the offence is transparent for all to see: for example, the year 2009 saw a total of 160,000 commercial activities in various Italian regions (mainly Sicily, Campania, Puglia and Calabria) being subject to extortion, with total revenues estimated to be near 9 billion euros.[16]

Footnote 14 continued
period of time and acting in concert with the aim of committing one or more serious crimes or offences […] in order to obtain, directly or indirectly, a financial or other material benefit".

[15] The last two activities of Mafia-type organizations were introduced into the Italian penal code in 1992 as part of the measures adopted after the Capaci and Via D'Amelio's massacres (where the judges Giovanni Falcone and Paolo Borsellino were killed). Additionally, art. 416 bis provides for the confiscation of mafia-owned properties.

[16] More precisely, the percentage of shops subject to extortion by mafia-type organizations is as high as 80% in the cities of Catania and Palermo (Sicily), 70% in Reggio Calabria (Calabria), and 50% in Naples (Campania) and the north of Bari and Foggia (Apulia). In the suburbs and hinterlands of these cities, the percentages are even higher, with almost all commercial activities being subject to extortion (including shops, restaurants, construction companies, and others). The average value of the pizzo for small businesses in these geographic areas amount to 100–200 euros per month in Naples and 200–500 euros per month

A further crime that is typically attributed to criminal organizations is bomb attacks. For the most part, this form of extreme violence is used to threaten and intimidate businessmen who resist being extorted, or politicians who refuse to collaborate. The obvious distinguishing feature of this offence is its visibility when actually committed. Consequently, official data on bomb attacks is much less prone to the problem of under-reporting, and may be used as additional information on other crimes (extortion, in particular) that are committed with the aid of such violence.[17]

As mentioned, the sum of the above five Mafia-related offences comprises our baseline index of organized crime (OC Index 5). To test the robustness of our benchmark findings, we also use a variety of other indices which include crimes of arson, serious robberies and kidnappings. Arson is considered for the same reason as bomb attacks, being indicative of extortionary activity (and more general intimidation) on the part of criminal groups. Serious roberries (defined as those committed in banks and post offices) are considered since they typically require a high degree of organization and collaboration amongst a plurality of individuals.[18] Kidnapping is considered because of the historical record of many Mafia organizations in specializing in this offence, as alluded to in previous studies (e.g., Ciconte 1992; Pinotti 2011).[19]

The general prediction of theoretical models, including BNR, is that both organized crime and corruption distort economic growth. If so, then the coefficients β_1 and β_2 in (1) would be negative and statistically significant. As indicated earlier, our primary focus is on the growth effect of organized crime conditional on the presence of corruption. This effect is captured by the coefficient β_3, a positive (negative) value of which would indicate that organized crime is less (more) damaging to growth in regions where corruption is more pronounced. The low correlation between the two key variables, which ranges from 0.09 to 0.31 depending on the measure of organized crime, allows for sufficient variation to estimate the relationship.

Our estimation methods include OLS, region fixed effects (FE) and dynamic panel techniques (difference-GMM and system-GMM), the latter commonly used in the empirical growth literature. The GMM estimations are the most appropriate since they are based on techniques that control for (i) potential endogeneity of the regressors, (ii) region-specific effects, and (iii) heteroskedasticity and autocorrelation within regions.[20] On the other hand, a difficulty associated with these estimators relates to

Footnote 16 continued
in Palermo. More elegant shops in the city centre pay almost 500–1000 euros in Naples and 750–1000 euros in Palermo. The average monthly pizzo is even higher for supermarkets, which are forced to pay the mafia up to 3000 euros in Naples and up to 5000 euros in Palermo. Construction sites may pay as much as 10,000 euros per month in Palermo. Asmundo and Lisciandra (2008) have estimated that in Sicily, the annual total revenues from extortion in 2009 were higher than 1 billion euros, which corresponds to more than 1.3 percent of regional GDP.

17 Of course, the picture is still incomplete since the mere threat of bomb attacks may preclude the need for them.

18 Serious robberies are also included in the OC index proposed by ISTAT.

19 According to Ciconte (1992), among 620 kidnapping cases that have been registered in Italy in the period 1969–1989, approximately 200 can be attributed to 'Ndrangheta and only 8, of more than 400, billions Italian lire that have been paid for kidnapping for extortion have been intercepted.

20 An advantage of these estimators is that they avoid a full specification of the serial correlation and heteroskedasticity properties of the error term, as well as any other distributional assumption. Further, the

the choice of the number of lags of the endogenous and predetermined variables. In order to restrict the number of instruments so as not to excessively exceed the number of regions (and thus avoid over fitting of the instrumented variables), we use a lag structure of two to four lags for difference-GMM and two to three lags for system-GMM.[21]

In both the system- and difference-GMM estimations, we test the validity of the instruments by applying two specification tests. The first is Hansen (1982) J-test of over-identifying restrictions which we use to examine the coherency of the instruments. The second is Arellano and Bond (1991) test for serial correlation of the disturbances up to second order. This test is important since the presence of serial correlation can cause a bias to both the estimated coefficients and standard errors. The appropriate check relates only to the absence of second-order serial correlation since first-differencing induces first-order serial correlation in the transformed errors.

The system-GMM estimator imposes an additional assumption to be satisfied relative to the difference-GMM estimator. This assumption requires a stationarity restriction on the initial conditions of GDP per capita. In particular, the region fixed effects have to be orthogonal to the lagged level of growth rates. According to Bond et al. (2001), this estimator has superior finite sample properties by combining "the standard set of equations in first-differences with suitably lagged levels as instruments, with an additional set of equations in levels with suitably lagged first-differences as instruments." Empirically, the validity of these additional instruments for the levels equation, which are the most suspect in system-GMM, is tested using a Difference-in-Hansen test that compares the first-differenced GMM and system-GMM results.

4 Data

We use a panel of 19 Italian regions for the period 1983–2009.[22] Depending on our measure of organized crime, the period considered in different estimations may vary due to data availability.[23] Table 7 in "Data appendix" section provides definitions,

Footnote 20 continued
system-GMM estimator is computed using the finite-sample correction to the two-step covariance matrix derived by Windmeijer (2005) which allows for the estimation of robust standard errors.

[21] We use a different lag structure for each estimator so that both estimators end up with similar number of instruments to assist comparability. In each case we have to collapse the instrument set so that we create one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance. In large samples *collapse* reduces statistical efficiency, but in small samples it can avoid the bias that arises as the number of instruments climbs toward the number of observations (Roodman 2006). We have also experimented with the use of just the second lag as an instrument and the use of fewer variables as being instrumented for (organized crime, corruption and their interaction) instead of collapsing the instruments. In each case the number of instruments greatly exceeds the number of regions, although our findings do not change. For this reason, we do not show these results.

[22] We exclude Valle d'Aosta, since it is the smallest and richest region and is usually excluded in the empirical analysis of Italian regions, being treated as an outlier.

[23] For instance, data on homicides by the Mafia, criminal association, extortion, arson and serious robberies are available from 1975, whilst data on Mafia criminal association and bomb attacks are available only from 1983 (after the change in the Italian Penal Code). The longest data are on the sum of extortion, kidnapping for extortion and serious robberies, being available since 1961 from CRENOS.

Table 1 Summary statistics

Variable	Mean	SD	Min	Max	Obs
GDP p.c. growth (%)	2.63	2.56	−3.95	11.63	257
Initial GDP p.c. (1990 lire)	18,900,000	8,068,528	4,165,179	39,000,000	257
Investment (% GDP)	24.81	6.68	15.81	71.55	240
Education	62.06	25.27	11.84	104.79	260
Inflation (%)	19.77	6.98	5.9	−4.52	260
Population growth (%)	4.06	3.67	0.12	16.01	257
Public spending (% GDP)	19.46	5.53	9.62	33.52	200
Trade (% GDP)	33.95	28.08	1.22	223.44	207
Financial development (% GDP)	20.03	3.33	12.29	27.54	140
Corruption	2.35	1.98	0.19	10.2	257
OC Index 5	10.67	7.41	2.78	43.12	160
Extortion	5.29	3.55	0.89	19.03	200
Criminal association	1.85	0.96	0.44	6	200
Mafia criminal association	0.3	0.5	0	2.95	160
Homicides by Mafia	0.24	0.71	0	6.73	200
Bomb attacks	2.37	4.28	0	24	160
Arsons	13.4	12.72	2.02	101.13	200
Robberies in banks	2.34	1.68	0	7.38	160
Robberies in posts	1.16	0.96	0	6.81	160
Kidnapping for extortion	0.24	0.2	0	1.11	200
OC Index ISTAT	20.51	15.53	4	76.61	120
OC Index CRENOS	38.93	40.6	3.19	295.12	200
OC Index Daniele and Marani	25.95	18.62	7.44	124.78	160
Homicides	1.54	1.62	0.21	12.85	257
PCA OC Index 5	1.25	1.65	−1.48	8.2	160

Data on GDP per capita growth, investment, inflation, secondary school enrolment, trade, public spending, financial development and population growth are from CRENOS and the Italian National Institute of Statistics (ISTAT), Annals of Statistics (various years). For these variables, summary statistics are based on average data for the period 1961–2009. Data on crimes are from ISTAT, Annals of Judicial Statistics (various years). The period of time considered for the averages depends on the availability of data (see Table 7 in "Data Appendix" section for a detailed description of the availability of data)

sources and the exact period availability of the data, whilst Table 1 presents some summary statistics. Following the standard approach, we construct 7 non-overlapping 4-year period averages (1983−1986, 1987−1990, . . . , 2007−2009) in order to minimize business cycles effects. This implies a maximum sample size of 133 observations when we use our baseline measure of organized crime (OC Index 5), though sometimes we end up working with fewer observations due to missing data.[24]

[24] When we use the measure of OC available since 1961, we construct 13 non-overlapping 4-year period averages (1961−1964, 1965−1968, . . . , 2008−2009) with a maximum sample size of 247 observations.

5 Baseline results

We begin our analysis by estimating Eq. (1) first with OLS and FE and then with difference- and system-GMM to account for the potential endogeneity of all the right-hand-side variables. The OLS and FE results are reported in Table 2, while the GMM results appear in Table 3 (difference-GMM in Panel A and system-GMM in Panel B). Each of the first five columns shows the results for a different measure of organized crime. Column 1 reports the results using the simplest index of organized crime—namely, Mafia criminal association. The subsequent columns give the results based on indices that are constructed by adding, in turn, each of the following types of organized crime: homicides by the Mafia, criminal association, bomb attacks, and extortion. The index used in column 5 (OC Index 5) is the most complete measure and represents our baseline measure of organized crime. Columns 6 and 7 also use this more complete index, but also control for a time trend and region fixed effects, respectively.

With regard to instrumentation, when using GMM techniques, the small number of Italian regions constrains us in keeping the maximum number of lags to four for difference-GMM and to three for system-GMM, in order to maintain the number of instruments at a minimum. Despite this tight restriction, in each case the instruments appear to be valid according to Hansen (1982) specification test, whilst the Arellano and Bond (1991) test does not reject the null hypothesis of no second-order serial correlation, at any acceptable level of significance. Similarly, the Difference-in-Hansen test, focusing on the additional instruments used by the system-GMM estimator, supports the instrument validity.[25]

Both Tables 2 and 3 illustrate the typical findings of growth regressions: there is conditional income convergence, a positive statistically significant effect of investment, and a negative statistically significant effect of inflation.[26] As found elsewhere in the empirical growth literature, both at the cross-country level (e.g., Benhabib and Spiegel 1994) and for the case of Italy (e.g., Di Liberto 2008), the coefficient on education is estimated to be negative. This result may be due to the specific measure of education that we use to proxy for human capital (secondary school enrolment rates) or due to the distorted structural composition of the Italian labor force and the inefficient allocation of human capital across sectors.

With regard to the variables of most interest to us, our results confirm those of previous studies, showing that the coefficients on corruption and organized crime are negative and statistically significant in all regressions at least at the 5% level (except

[25] It is due to this characteristic that the system-GMM estimator yields an improvement in precision over its difference counterpart. For this reason, we use this estimator in our various sensitivity analysis following below.

[26] Note that income convergence takes shape only when we control for region fixed effects in the last column of Table 2 and with the difference-GMM regression at the top panel of Table 3. Further, comparing the coefficient estimate of initial GDP per capita across the OLS, within-regions and difference-GMM estimators, we observe that the estimate associated with the difference-GMM estimator lies between those of the OLS levels and the within-regions estimators, which according to Bond et al. (2001) is in line with a consistent estimate of initial GDP per capita. In particular, had the difference-GMM estimator of initial income lied above the corresponding within-regions estimate, there would have been concerns that the difference-GMM estimates are biased due to weak instruments. This, however, does not appear to the case in our regressions, lending further support to the Hansen J-test and the validity of our instruments.

Table 2 OLS estimations

Dependent variable: GDP pc growth	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Initial GDP per capita (log)	−0.534	−0.589	−0.132	−0.871	−1.326	−0.425	−10.07
	(0.509)	(0.448)	(0.869)	(0.260)	(0.088)	(0.595)	(0.001)
Inflation	−0.269	−0.280	−0.263	−0.279	−0.292	−0.368	−0.420
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	−0.045	−0.048	−0.044	−0.046	−0.040	−0.011	−0.026
	(0.001)	(0.000)	(0.002)	(0.001)	(0.003)	(0.555)	(0.296)
Investment	0.078	0.074	0.078	0.075	0.067	0.105	0.174
	(0.069)	(0.084)	(0.067)	(0.058)	(0.073)	(0.009)	(0.022)
Corruption	−0.248	−0.238	−0.419	−0.277	−0.492	−0.525	−0.442
	(0.019)	(0.019)	(0.000)	(0.028)	(0.000)	(0.000)	(0.010)
Organized crime	−1.051	−0.459	−0.257	−0.110	−0.131	−0.099	−0.060
	(0.046)	(0.014)	(0.036)	(0.002)	(0.000)	(0.005)	(0.269)
Corruption*Organized crime	0.173	0.075	0.072	0.014	0.021	0.021	0.021
	(0.065)	(0.126)	(0.011)	(0.036)	(0.002)	(0.003)	(0.000)
Regions/Obs	19/133	19/133	19/133	19/133	19/133	19/133	19/133
R^2	0.350	0.355	0.356	0.357	0.393	0.410	0.535

Dependent variable is the GDP per capita growth rate. *p* values in parentheses. Constant term not reported. Regressions based on OLS, except for column (7) which is based on region fixed effects. Column (6) adds a time trend, not reported. The measures of OC are as follows: Mafia crim. assoc. (Column 1); Mafia crim. assoc. + homicides by Mafia (Column 2); Mafia crim. assoc.+ homicides by Mafia + crim. assoc. (Column 3); Mafia crim. assoc.+ homicides by Mafia + crim. assoc. + bomb attacks (Column 4); OC Index 5: Mafia crim. assoc.+ homicides by Mafia + crim. assoc.+ bomb attacks+ extortion (Columns 5–7)

Table 3 GMM estimations

	[1]	[2]	[3]	[4]	[5]
Panel A: Difference-GMM					
Initial GDP per capita (log)	−7.47	−6.29	−9.18	−8.87	−8.97
	(0.000)	(0.031)	(0.000)	(0.000)	(0.000)
Inflation	−0.369	−0.405	−0.482	−0.361	−0.422
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	−0.038	−0.052	−0.066	−0.020	−0.033
	(0.038)	(0.054)	(0.003)	(0.223)	(0.046)
Investment	0.284	0.248	0.372	0.147	0.255
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Corruption	−0.297	−0.256	−0.394	−0.472	−0.635
	(0.043)	(0.043)	(0.007)	(0.000)	(0.000)
Organized crime	−3.082	−0.786	−0.220	−0.262	−0.140
	(0.000)	(0.000)	(0.015)	(0.000)	(0.000)
Corruption*Organized crime	0.424	0.114	0.201	0.026	0.039
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Regions/Obs	19/114	19/114	19/114	19/114	19/114
Number of instruments	21	21	21	21	21
Hansen *J*-test (*p* value)	0.338	0.256	0.258	0.256	0.239
AR(1) test (*p* value)	0.005	0.003	0.004	0.003	0.002
AR(2) test (*p* value)	0.717	0.341	0.442	0.933	0.900
No. of lags of endogenous variables used as instruments	2_4	2_4	2_4	2_4	2_4
Panel B: System-GMM					
Initial GDP per capita (log)	−1.60	−0.60	−1.20	−3.06	−1.73
	(0.059)	(0.424)	(0.207)	(0.001)	(0.151)
Inflation	−0.351	−0.386	−0.345	−0.322	−0.308
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	−0.079	−0.092	−0.080	−0.055	−0.053
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Investment	0.218	0.256	0.176	0.107	0.108
	(0.000)	(0.000)	(0.001)	(0.006)	(0.007)
Corruption	−0.206	−0.196	−0.749	−0.367	−0.795
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
Organized crime	−2.045	−0.720	−0.521	−0.160	−0.126
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Corruption*Organized crime	0.316	0.143	0.210	0.017	0.039
	(0.000)	(0.000)	(0.000)	(0.039)	(0.000)
Regions/Obs	19/133	19/133	19/133	19/133	19/133
Number of instruments	22	22	22	22	22
Hansen *J*-test (*p* value)	0.272	0.279	0.491	0.324	0.348
Difference-in-Hansen *J*-test (*p* value)	0.733	0.747	0.990	0.943	0.956

Table 3 continued

	[1]	[2]	[3]	[4]	[5]
AR(1) test (*p* value)	0.004	0.003	0.002	0.003	0.002
AR(2) test (*p* value)	0.244	0.133	0.841	0.147	0.25
No. of lags of endogenous variables used as instruments	2_3	2_3	2_3	2_3	2_3

Dependent variable is the GDP per capita growth rate. *p* values in parentheses. Constant term not reported. Regressions based on Difference-GMM (Panel A) and System-GMM (Panel B). The System-GMM estimator is computed using the Windmeijer (2005) two-step procedure. All control variables are instrumented for. The measures of OC are as described in Table 2

in the last column of Table 2 where organized crime is not statistically significant). Interestingly, the interaction term coefficient is positive and significant, at the 1% level in the GMM regressions. Together, these findings indicate that each type of illegal activity has an adverse impact on growth, but that the impact of organized crime is less severe in the presence of corruption. The general implication of this is that the extent to which corruption occurs is an important factor in determining the negative growth effect of organized crime. The specific implication is that the presence of corruption tends to mitigate this effect. Our findings reflect within-region variation and are qualitatively very strong, though there is obviously variation in the quantitative magnitude of the coefficients depending on the particular measure of organized crime.

6 Robustness checks

In what follows we test the robustness of the baseline results under various modifications of our analysis. These include consideration of different regression specifications and the use of alternative measures of organized crime.

6.1 Robustness to different regression specifications

As previously discussed, a difficulty associated with the dynamic GMM estimators relates to the choice of the number of lags of the endogenous variables that are used as instruments. So far, our system-GMM results have been obtained by using a length of two to three lags in order to limit the number of instruments. As a robustness test, we reduce the length of the maximum lags to two so that we only use the second lagged value of a variable as its instrument. The results are shown in Column 2 of Table 4, while Column 1 reproduces Column 5 of Panel B in Table 3 for comparison purposes. Our findings remain intact and the coefficient estimates are very stable.

We further check the robustness of our baseline findings by adding more control variables usually found in growth regressions: these include the rate of population growth, the share of total public spending to GDP, the ratio of trade to GDP, and a measure of financial development. The results are reported in Columns 3–6 of Table 4. Once again, our main results remain unaltered, with some of the additional regressors having the expected sign and being statistically significant (public spending and financial development).

Table 4 Robustness tests to additional controls and dummy interactions

Dependent variable: GDP pc growth	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Initial GDP per capita (log)	−1.73	−2.66	−0.65	−1.13	−2.33	−1.27	−0.96	−4.92
	(0.151)	(0.165)	(0.686)	(0.325)	(0.027)	(0.321)	(0.503)	(0.366)
Inflation	−0.308	−0.333	−0.311	−0.342	−0.364	−0.115	−0.331	−0.491
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Education	−0.053	−0.044	−0.039	−0.039	−0.042	−0.047	−0.053	−0.039
	(0.000)	(0.021)	(0.055)	(0.014)	(0.079)	(0.003)	(0.008)	(0.526)
Investment	0.108	0.219	0.239	0.268	0.214	−0.012	0.223	0.212
	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.822)	(0.000)	(0.183)
Corruption	−0.795	−0.813	−0.848	−0.851	−0.812	−0.330	−0.796	−3.433
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.032)
Organized crime	−0.126	−0.102	−0.195	−0.167	−0.167	−0.148	−0.144	−0.779
	(0.000)	(0.018)	(0.040)	(0.000)	(0.000)	(0.001)	(0.001)	(0.039)
Corruption*Organized crime	0.039	0.036	0.051	0.054	0.051	0.020	0.045	0.250
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.020)	(0.000)	(0.054)
Population growth			0.31	0.16	0.159	0.261		
			(0.021)	(0.169)	(0.112)	(0.001)		
Public spending				−0.163	−0.164	0.050		
				(0.003)	(0.001)	(0.326)		
Trade					0.009	−0.016		
					(0.298)	(0.061)		
Financial development						0.164		
						(0.043)		
Corr*OC*1980s							0.019	
							(0.437)	
Corr*OC*1990s							0.000	
							(0.931)	
Corr*OC*Campania								−0.069
								(0.246)
Corr*OC*Calabria								−0.074
								(0.213)
Corr*OC*Sicilia								−0.073
								(0.169)
Corruption*OC*Puglia								0.019
								(0.926)
Corruption*OC*Basilicata								0.064
								(0.425)
Corruption*OC*Molise								−0.104
								(0.210)

Table 4 continued

Dependent variable: GDP pc growth	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Corruption*OC*Lazio								−0.255
								(0.401)
Corruption*OC*Liguria								0.246
								(0.191)
Regions/Obs	19/133	19/133	19/133	19/133	19/130	19/111	19/133	19/134
Number of instruments	22	15	17	19	21	23	18	31
Hansen *J*-test (*p* value)	0.348	0.072	0.079	0.074	0.103	0.666	0.077	0.778
AR(1) test (*p* value)	0.002	0.003	0.008	0.004	0.009	0.006	0.003	0.001
AR(2) test (*p* value)	0.25	0.572	0.276	0.322	0.419	0.317	0.368	0.234
No. of lags of endogenous variables used as instruments	2_3	2_2	2_2	2_2	2_2	2_2	2_2	2_2

Dependent variable is the GDP per capita growth rate. *p* values in parentheses. Constant term not reported. Regressions based on System-GMM. All control variables are instrumented for. OC measured by the baseline index, OC Index 5

In some Italian regions (for instance Puglia, Basilicata, Lazio, Liguria, Molise) organized crime is a relatively recent phenomenon. Thus, it is possible that our results may be driven by variations in organized crime across time. In order to control for this variability, we estimate the regression by adding interaction terms of corruption, organized crime and decadal dummies.[27] The results are reported in Column 7 of Table 4, and they show that decadal differences in organized crime do not seem to matter for growth. It is also possible that our findings are driven by regional differences in organized crime experience. We account for such regional dissimilarities by adding interaction terms of corruption, organized crime and territorial dummy variables for regions where organized criminality is more widespread.[28] The results are reported in the last column of Table 4, and they show that our main findings are still robust. Further, the region-specific estimates of the interaction between organized crime and corruption are not statistically significant.

6.2 Robustness to alternative measures of organized crime

For the most part of the preceding analysis, we have used OC Index 5 as our preferred measure of organized crime. It is important to verify that our results can be established

[27] Since our baseline measure of organized crime is available for the period 1983–2009, we account for the two decades 1980s and 1990s, excluding the 2000s so as to avoid the so-called dummy-trap.

[28] As before, the regions have been classified on the base of the data on mafia-type criminal association (art. 416 bis of the Italian Penal Code) averaged for the period 1983–2009. The regions with the highest number of these crimes, in diminishing order, are: Sicily, Calabria, Campania, Puglia, Basilicata, Molise, Lazio, and Liguria.

using other measures that have been adopted in the literature. To this end, we construct additional indices of organized crime by considering different combinations of Mafia-related offences and applying them in estimations of Eq. (1). Being highly correlated, these indices are not expected to produce results that are substantially different from those based on our OC Index 5. Table 5 confirms this.

Column 1 replicates Column 5 of Table 3 (Panel B) for comparison. As discussed earlier, this baseline measure is constructed as the sum of official data recorded on five different types of crime that are defined as being proof, or deemed symptomatic, of the presence of criminal organizations (i.e., criminal association, Mafia criminal association, homicides by Mafia, bomb attacks, and extortion). Column 2, instead, reports the results using an index that excludes criminal association and extortion, but which proxies the latter by arson and bomb attacks as the primary means of exacting payments from businesses (e.g., Confesercenti 2009; Daniele and Marani 2010). The subsequent columns take OC Index 5 and add successively arson (Column 3), kidnapping for extortion (Column 4), and both arson and kidnapping for extortion (Column 5).

Added to the above are results based on three further measures of organized crime. The first of these (Column 6) is the index of organized crime proposed by Daniele and Marani (2010). This differs from our baseline index in its exclusion of homicides by the Mafia but inclusion of arson. The second (Column 7) is the measure produced by the Italian National Institute of Statistics (ISTAT), as used by Caruso (2008). This is based on the definition of criminal organization given by the Italian Minister of Interiors, and includes the crimes of homicides by the Mafia, bomb attacks, arson and serious robberies.[29] The third (Column 8) is an index constructed more broadly from data on extortion, kidnapping for extortion and serious robberies (available from CRENOS). This is not strictly associated with organized crime, but may be regarded as closely proxying it for reasons given earlier, and has the appeal of covering a relatively long time span (beginning from 1961).

As Table 5 shows, the use of alternative measures of organized crime makes little difference to our original results. The growth effects of our three key variables—organized crime, corruption and the interaction between these—remain statistically significant and in the same direction (i.e., negative, negative and positive). An additional set of results presented in Column 9 of the Table relate specifically to the interaction term. One might raise the question about whether the effect of this term is specific to organized crime, or whether it extends to other types of crime. To address this question, we conduct a falsification test, where organized crime is replaced by a measure of normal crime. A natural choice of the latter is intentional homicide, given that such crime is well-reported and given that it has a well-known distortionary effect on growth (e.g., Cárdenas and Rozo 2008; Detotto and Otranto 2010). Our results confirm this effect, whilst also demonstrating that its magnitude is not conditional on the presence or absence of corruption. In other words, the interaction term is not statistically significant. This implies that our previously robust finding of a positive

[29] Rather than using directly the index given by ISTAT, we construct an index as the sum of organized crime offences identified by this institute. We do so because of the relatively short time span of the original data, which covers 1995–2003, 2006 and 2008–2010. By contrast, our reconstructed measure provides coverage for 1983–2009.

Table 5 Robustness to alternative measures of (organized) crime

Dependent variable: GDP pc growth	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	OC Index 5	MA+HM+BA+Ar	OC5+Ar	OC5+KE	OC5+Ar+KE	Daniele and Marani	ISTAT Caruso	1961–2009	Homicides
Initial GDP per capita (log)	−1.73	−1.62	−2.66	−2.37	−1.92	−1.95	−1.98	−1.97	−8.22
	(0.151)	(0.185)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.025)	(0.000)
Inflation	−0.308	−0.306	−0.316	−0.316	−0.324	−0.325	−0.257	−0.177	−0.322
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	−0.053	−0.053	−0.031	−0.036	−0.041	−0.042	−0.07	0.004	−0.028
	(0.000)	(0.000)	(0.002)	(0.011)	(0.002)	(0.001)	(0.000)	(0.691)	(0.002)
Investment	0.108	0.106	0.048	0.097	0.083	0.090	0.056	0.204	0.022
	(0.007)	(0.009)	(0.424)	(0.008)	(0.104)	(0.057)	(0.215)	(0.000)	(0.280)
Corruption	−0.795	−0.809	−0.811	−0.761	−0.769	−0.752	−0.281	−0.551	−0.772
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.057)	(0.000)	(0.000)
Crime	−0.126	−0.12	−0.076	−0.044	−0.045	−0.042	−0.040	−0.029	−0.614
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.015)	(0.000)	(0.000)
Corruption* Crime	0.039	0.039	0.014	0.009	0.010	0.009	0.006	0.007	0.021
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)	(0.000)	(0.734)
Regions/Obs	19/133	19/133	19/133	19/133	19/133	19/133	19/114	19/171	19/133
Number of instruments	22	22	22	22	22	22	22	22	22

Table 5 continued

Dependent variable: GDP pc growth	[1] OC Index 5	[2] MA+HM+BA+Ar	[3] OC5+Ar	[4] OC5+KE	[5] OC5+Ar+KE	[6] Daniele and Marani	[7] ISTAT Caruso	[8] 1961–2009	[9] Homicides
Hansen *J*-test (*p* value)	0.348	0.347	0.280	0.284	0.246	0.257	0.548	0.360	0.227
AR(1) test (*p* value)	0.002	0.002	0.002	0.002	0.002	0.002	0.008	0.000	0.019
AR(2) test (*p* value)	0.250	0.262	0.470	0.506	0.505	0.513	0.087	0.203	0.817
No. of lags of endogenous variables used as instruments	2_3	2_3	2_3	2_3	2_3	2_3	2_3	2_3	2_3

Dependent variable is the GDP per capita growth rate. *p* values in parentheses. Constant term not reported. Regressions based on system-GMM. All control variables are instrumented for. OC is measured as follows: OC Index 5 (Column 1); Mafia association+ homicides by Mafia + bomb attacks + arsons (Column 2); OC Index 5 + arsons (Column 3); OC Index 5 + kidnapping for extortion (Column 4); OC Index 5 + arsons + kidnapping for extortion (Column 5); OC index proposed by Daniele and Marani (2010): extortion + bomb attacks + arsons + criminal association + Mafia criminal association (Column 6); ISTAT OC index: homicides by Mafia + bomb attacks + arsons + serious robberies (Column 7); OC index which includes: serious robberies + kidnapping for extortion + extortion (Column 8)

Table 6 Robustness to alternative PCA indexes of organized crime

Dependent variable: GDP pc growth	[1]	[2]	[3]	[4]	[5]
	Index 3	Index 4	Index 5	Index 6	ISTAT Index
Initial GDP pc (log)	−0.28	−0.82	−0.22	−1.67	−2.48
	(0.745)	(0.411)	(0.805)	(0.080)	(0.000)
Inflation	−0.35	−0.363	−0.349	−0.373	−0.255
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	−0.083	−0.086	−0.083	−0.080	−0.060
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Investment	0.188	0.215	0.188	0.197	−0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.967)
Corruption	−0.225	−0.137	−0.197	−0.144	−0.279
	(0.000)	(0.002)	(0.002)	(0.079)	(0.000)
Organized crime	−0.609	−0.515	−0.463	−0.571	−0.765
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Corruption*Organized crime	0.268	0.138	0.174	0.105	0.112
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Regions/Obs	19/133	19/133	19/133	19/133	19/133
Number of instruments	22	22	22	22	22
Hansen *J*-test (*p* value)	0.318	0.272	0.280	0.239	0.046
AR(1) test (*p* value)	0.002	0.002	0.002	0.001	0.004
AR(2) test (*p* value)	0.893	0.132	0.259	0.239	0.273
No. of lags of endogenous variables used as instruments	2_3	2_3	2_3	2_3	2_3

Dependent variable is the GDP per capita growth rate. *p* values in parentheses. Constant term not reported. Regressions based on system-GMM. All control variables are instrumented for. Index 3: PCA of Mafia criminal association, homicides by Mafia, criminal association; Index 4: PCA of Mafia criminal association, homicides by Mafia, criminal association, bomb attacks; Index 5: PCA of crime variables in baseline measure OC Index 5; Index 6: PCA of Mafia criminal association, homicides by Mafia, bomb attacks, arsons; ISTAT Index: PCA of crime variables in ISTAT Index

interaction term is likely to reflect an association between organized crime (rather than general crime) and corruption.

To this point, our indices for organized crime have been constructed as the sum of various Mafia-related crimes. As a final robustness check of our results, we use measures of organized crime obtained from Principal Component Analysis (PCA).[30] Table 6 reports our results using alternative measures of organized crime based on the PCA procedure. Column 1 relates to crimes of criminal assocation, Mafia association

[30] Generally speaking, PCA is a statistical technique that is used for data reduction. It is appropriate when one has data on a number of variables that are correlated with each other (possibly because they are measuring the same phenomena), in which case one can reduce the number of these observable variables into a smaller number of artificial variables (the principal components) that account for most of the variation in the observables.

and Mafia homicides. Column 2 extends this to include bomb attacks, whilst Column 3 makes a further extension to include extortion (corresponding to our baseline OC Index 5). Column 4 adds arson to the list of offences and excludes criminal association and extortion, and Column 6 refers to the list of offences suggested by ISTAT. In each and every case, our main results are unchanged.

7 Conclusion

This paper has sought to cast further light on the growth implications of organized crime and its interaction with corruption. The adverse effects of these two phenomena on growth and development are well-documented, and the fight against each of them remains high on the agendas of national and international agencies. What is less well-understood is the extent to which their impacts might be reinforced or subdued through linkages between them. The mechanics of this ambiguity have been documented in a companion paper, by BNR, and briefly summarized in this study. In this paper, our primary objective is to take the analysis further in an effort to resolve this ambiguity. We do this by investigating empirically whether organized crime distorts economic growth by a different degree when acting alone compared to when co-existing with corruption. The long and strong presence of both these illicit activities in Italy, make this country a natural choice to apply our examination.

BNR show how organized crime alone creates an unfavorable climate for business activity by raising the costs of this activity through extortion. The upshot is that growth is lower than would otherwise be the case. This is what one would expect, but the study further demonstrates how the impact of organized crime may be conditional on the presence of corruption. Results indicate that this conditionality could go either way—organized crime may be more or less damaging if it co-exists with corruption. The intuition is that since corruption operates as a tax on criminality, the outcome depends on the expected payoffs of the crime syndicate when having to pay bribes to corrupt law officers. This, in turn, depends on the trade-off between a lower supply of crimes and the probability these crimes are more likely to be successful. If corruption, despite its direct cost to criminals, leads to higher (lower) expected payoff from extortion, then the growth-diminishing effect of crime is greater (smaller) in the presence of corruption.

Building on the inconclusive theoretical forecast of our companion study, the empirical analysis in this paper provides clear evidence that resolves the above ambiguity with reference to Italy. The key aspect of our empirical specification is the inclusion of an interaction term between organized crime and corruption in our growth regressions. Using different methodologies and datasets, we find that both organized crime and corruption have a negative effect on economic growth, while the coefficient on their interaction term is consistently positive and statistically significant. The implication is that organized crime is less damaging to growth in the presence, rather than the absence, of corruption. This provides strong support in favor of one of the two possible, and plausible, theoretical predictions alluded to earlier. At the same time, our finding highlights the importance of treating jointly the two illegal phenomena of organized crime and corruption in the context of growth analysis.

Data appendix

See Table 7.

Table 7 Description of variables and sources

Variables	Description	Sources
GDP growth pc	Log difference of GDP per capita in thousands of millions of lire (constant 1990 prices)	ISTAT-Annals of Statistics and CRENoS-1961/2009
Initial GDP pc (log)	Log of initial GDP per capita in thousands of millions of lire (constant 1990 prices)	ISTAT-Annals of Statistics and CRENoS-1961/2009
Investment	Share of gross private investment (% of GDP)	ISTAT-Annals of Statistics and CRENoS-1961/2009
Education	Percentage of population in age range 14–18 registered in high school	ISTAT-Annals of Statistics and CRENoS-1961/2009
Inflation	GDP deflator	ISTAT-Annals of Statistics and CRENoS-1961/2009
Population growth	Population growth rate	ISTAT-Annals of Statistics-1961/2009
Public spending	Share of total public spending (% of GDP)	ISTAT-Annals of Statistics-1961/2009
Trade	Share of trade (% of GDP)	ISTAT-Annals of Statistics-1961/2009
Financial development	Share of value added of financial and banking sector (% of GDP)	ISTAT-Annals of Statistics and CRENoS-1975/2009
Corruption	Number of crimes against Public Administration (PA) based on Statues no. 286 through 294. Excluding crimes against PA that do not involve corruption such as Statute 279 (insulting a public officer) and Statute 295 (neglect or refusal of an official duty) reported to the police, per 100,000 inhabitants. These crimes include embezzlement and misallocation of public funds	ISTAT-Annals of Judicial Statistics-1961/2009

Table 7 continued

Variables	Description	Sources
OC Index 5	Sum of the following crimes: Mafia criminal association, homicides by Mafia, criminal association, bomb attacks, extortion (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1983/2009
Extortion	Number of crimes of extortion denounced (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1975/2009
Criminal Association *(art.416)*	Number of crimes of criminal association (per 100,000 inhabitants) defined as: *"the association of three or more people who are organized in order to commit a plurality of crimes"*	ISTAT-Annals of Judicial Statistics-1975/2009
Mafia Criminal Association *(art.416 bis)*	Number of crimes of Mafia criminal association (per 100,000 inhabitants) defined as:*"the association is of the Mafia type when its components use intimidation, awe and silence in order to commit crimes, to acquire the control or the management of business activities (i.e., concessions, permissions, public contracts or other public services), to derive profit or advantages for themselves or others, to limit the freedom of exerting the right to vote, and to find votes for themselves or others during the electoral campaign."*	ISTAT-Annals of Judicial Statistics-1983/2009
Homicides by Mafia	Number of homicides by mafia (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1975/2009
Bomb attacks	Number of bomb attacks (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1983/2009
Arsons	Number of arsons (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1975/2009
Robberies in Banks	Number of robberies in banks (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1975/2009
Robberies in Post Offices	Number of robberies in post offices (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1975/2010
Kidnapping for extortion	Number of kidnapping for extortion (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1975/2011

Table 7 continued

Variables	Description	Sources
OC Index ISTAT	Sum of the following crimes: homicides by Mafia, bomb attacks, arsons, serious robberies (in banks and post offices) per 100,000 inhabitants	ISTAT-Annals of Judicial Statistics-1983/2009
OC Index CRENOS	Sum of the following crimes: extortion, kidnapping for extortion, serious robberies (in banks and post offices) per 100,000 inhabitants	ISTAT-Annals of Statistics and CRENoS-1961/2009
OC Index Daniele–Marani	Sum of the following crimes: extortion, bomb attacks, arsons, criminal association, Mafia criminal association (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1983/2009
Homicides	Number of intentional homicides (per 100,000 inhabitants)	ISTAT-Annals of Judicial Statistics-1960/2010
PCA OC Index 5	Principal Component Analysis of the crimes included in OC Index 5	ISTAT-Annals of Judicial Statistics-1983/2009

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